ChipCorder®
TECHNOLOGY BY ISD

ISD1100 Series

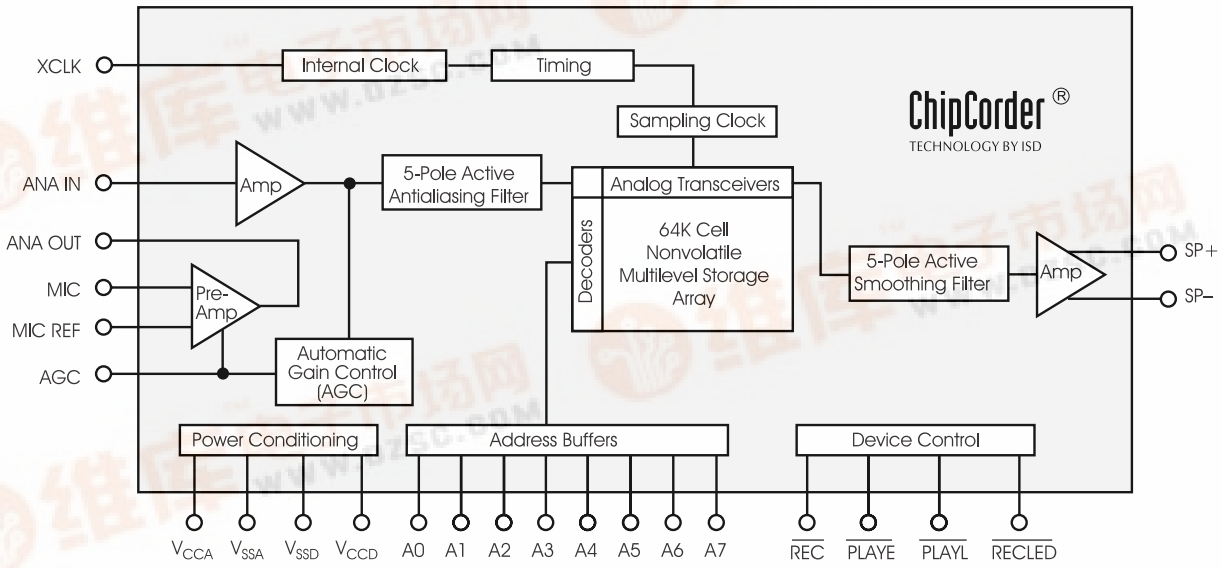
Single-Chip Voice Record/Playback Device
10- and 12-Second Durations

GENERAL DESCRIPTION

Information Storage Devices' ISD1100 ChipCorder® Series provides high-quality, single-chip record/playback solutions to 10- and 12-second messaging applications. The CMOS devices include an on-chip oscillator, microphone preamplifier, automatic gain control, antialiasing filter, smoothing filter, and speaker amplifier. A minimum record/playback subsystem can be configured with a microphone, a speaker, several passives, two push-buttons, and a power source.

Recordings are stored in on-chip nonvolatile memory cells, providing zero-power message storage. This unique, single-chip solution is made possible through ISD's patented multilevel storage technology. Voice and audio signals are stored directly into memory in their natural form, providing high-quality, solid-state voice reproduction.

Figure : ISD1100 Series Block Diagram



FEATURES

- Easy-to-use single-chip voice record/playback solution
- High-quality, natural voice/audio reproduction
- Push-button interface
  - Playback can be edge- or level-activated
- Single-chip durations of 10 and 12 seconds
- Automatic power-down mode
  - Enters standby mode immediately following a record or playback cycle
  - 0.5 μA standby current (typical)
- Zero-power message storage
  - Eliminates battery backup circuits
- Fully addressable to handle multiple message
- 100,000 record cycles (typical)
- On-chip clock source
- No programmer or development system needed
- Single +5 volt power supply
- Available in die form, DIP and SOIC
- 100-year message retention (typical)

Table: ISD1100 Series Summary

Part Number	Minimum Duration (Seconds)	Input Sample Rate (KHz)	Typical Filter Pass Band (KHz)
ISD1110	10	6.4	2.6
ISD1112	12	5.3	2.2

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FIGURES, CHARTS, AND TABLES IN THE ISD1100 SERIES DATASHEET

DETAILED DESCRIPTION

SPEECH/SOUND QUALITY

ISD's patented ChipCorder technology provides natural record and playback. The ISD1100 series includes devices offered at 5.3 and 6.4 KHz sampling frequencies, allowing the user a choice of speech quality options. The input voice signals are stored directly in nonvolatile EEPROM cells and are reproduced without the synthetic effect often heard with digital solid-state speech solutions. A complete sample is stored in a single cell, minimizing the memory necessary to store a recording of a given duration.

DURATION

The ISD1100 series devices offers single-chip solutions for 10 and 12 seconds.

EEPROM STORAGE

One of the benefits of ISD's ChipCorder technology is the use of on-chip nonvolatile memory, providing zero-power message storage. The message is retained for up to 100 years typically without power. In addition, the device can be re-recorded typically over 100,000 times.

BASIC OPERATION

The ISD1100 ChipCorder series devices are controlled by a single signal, $\overline{\text{REC}}$, and either of two push-button control playback signals, $\overline{\text{PLAYE}}$ (edge-activated playback), and $\overline{\text{PLAYL}}$ (level-activated playback). The ISD1100 series parts are configured for simplicity of design in a single-message application. Device operation is explained on page 14.

AUTOMATIC POWER-DOWN MODE

At the end of a playback or record cycle, the ISD1100 series devices automatically return to a low-power standby mode, consuming typically 0.5 μA. During a playback cycle, the device powers down automatically at the end of the message. During a record cycle, the device powers down immediately after $\overline{\text{REC}}$ is released HIGH.

LOOPING CAPABILITY

The ISD1100 series devices have a built-in looping function, enabling the continuous repeating of a single message. Looping is initiated by a negative transition on the $\overline{\text{PLAYE}}$ pin with A3 held HIGH. $\overline{\text{PLAYE}}$ is then brought back HIGH. Looping will continue indefinitely with all three control pins ($\overline{\text{PLAYL}}$, $\overline{\text{PLAYE}}$, and $\overline{\text{REC}}$) remaining HIGH. Pulsing $\overline{\text{PLAYL}}$ LOW will end the playback.

ADDRESSING (OPTIONAL)

In addition to providing simple message playback, the ISD1100 series devices provide a full addressing capability.

The ISD1100 series devices have 80 distinct addressable segments providing the following resolution per segment. See Application Information for ISD1100 series devices address tables.

Table 1: Device Playback/Record Durations

Part Number	Minimum Duration (Seconds)
ISD1110	125 ms
ISD1112	150 ms

PIN DESCRIPTIONS

NOTE *The $\overline{REC}$ signal is debounced for 50 ms on the rising edge to prevent a false retriggering from a push-button switch. $\overline{REC}$, PLAYL, and $\overline{PLAYE}$ have internal pullups to V_{CC}. Holding one of these pins LOW will increase standby current consumption.*

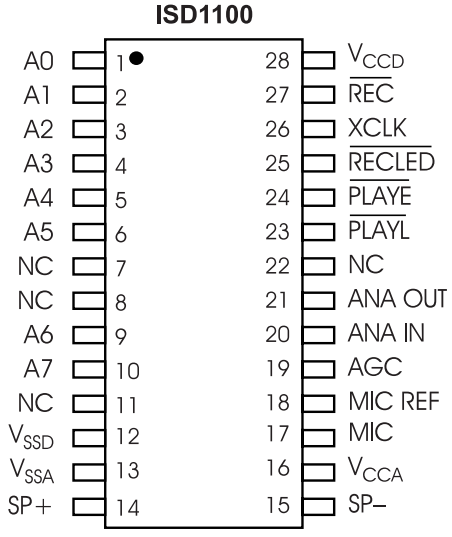
VOLTAGE INPUTS (V_{CCA}, V_{CCD})

Analog and digital circuits internal to the ISD1100 series devices use separate power buses to minimize noise on the chip. These power buses are brought out to separate pins on the package and should be tied together as close to the supply as possible. It is important that the power supply be decoupled as close as possible to the package.

GROUND INPUTS (V_{SSA}, V_{SSD})

Similar to V_{CCA} and V_{CCD}, the analog and digital circuits internal to the ISD1100 series devices use separate ground buses to minimize noise. These pins should be tied together as close as possible to the device.

Figure 1: ISD1100 Series Pinout



DIP/SOIC

NOTE: *NC means must Not Connect.*

RECORD ($\overline{REC}$)

The $\overline{REC}$ input is an active-LOW record signal. The device records whenever $\overline{REC}$ is LOW. This signal must remain LOW for the duration of the recording. $\overline{REC}$ takes precedence over either playback ($\overline{PLAYE}$ or $\overline{PLAYL}$) signal. If $\overline{REC}$ is pulled LOW during a playback cycle, the playback immediately ceases and recording begins.

A record cycle is completed when $\overline{REC}$ is pulled HIGH. An end-of-message (EOM) marker is internally recorded, enabling a subsequent playback cycle to terminate appropriately. The device automatically powers down to standby mode when $\overline{REC}$ goes HIGH. This pin has an internal pull-up device.

PLAYBACK, EDGE-ACTIVATED ($\overline{PLAYE}$)

When a LOW-going transition is detected on this input signal, a playback cycle begins. Playback continues until an end-of-message marker is encountered or the end of the memory space is reached. Upon completion of the playback cycle, the device automatically powers down into standby mode. Taking $\overline{PLAYE}$ HIGH during a playback cycle will not terminate the current cycle. This pin has an internal pull-up device.

PLAYBACK, LEVEL-ACTIVATED ($\overline{PLAYL}$)

When this input signal transitions from HIGH to LOW, a playback cycle is initiated. Playback continues until $\overline{PLAYL}$ is pulled HIGH, an end-of-message marker is detected, or the end of the device space is reached. The device automatically powers down to standby mode upon completion of the playback cycle. This pin has an internal pull-up device.

NOTE *In playback, if either $\overline{PLAYE}$ or $\overline{PLAYL}$ is held LOW during EOM or OVERFLOW, the device will still enter standby and the internal oscillator and timing generator will stop. However, the rising edge of $\overline{PLAYE}$ and $\overline{PLAYL}$ are not debounced, and any subsequent falling edge (particularly switch bounce) present on the input pins will initiate another playback.*

RECORD LED OUTPUT ($\overline{\text{RECLED}}$)

The output $\overline{\text{RECLED}}$ is LOW during a record cycle. It can be used to drive an LED to provide feedback that a record cycle is in progress. In addition, $\overline{\text{RECLED}}$ pulses LOW momentarily when an end-of-message marker is encountered in a playback cycle.

MICROPHONE INPUT (MIC)

The microphone input transfers its signal to the on-chip preamplifier. An on-chip Automatic Gain Control (AGC) circuit controls the gain of the preamplifier from –15 to 24 dB. An external microphone should be AC coupled to this pin via a series capacitor. The capacitor value, together with the internal 10 KΩ resistance on this pin, determine the low-frequency cutoff for the ISD1100 series passband. See ISD Application Information for additional information on low-frequency cutoff calculations.

MICROPHONE REFERENCE (MIC REF)

The MIC REF input is the inverting input to the microphone preamplifier. This provides a noise-cancelling, or common-mode rejection, input to the device when connected differentially to a microphone.

AUTOMATIC GAIN CONTROL (AGC)

The AGC dynamically adjusts the gain of the preamplifier to compensate for the wide range of microphone input levels. The AGC allows the full range of sound, from whispers to loud sounds, to be recorded with minimal distortion. The "attack" time is determined by the time constant of a 5 KΩ internal resistance and an external capacitor (C6 on Figure 4) connected from the AGC pin to V_{SSA} analog ground. The "release" time is determined by the time constant of an external resistor (R5) and an external capacitor (C6) connected in parallel between the AGC pin and V_{SSA} analog ground. Nominal values of 470 KΩ and 4.7 µF give satisfactory results in most cases.

ANALOG OUTPUT (ANA OUT)

This pin provides the preamplifier output to the user. The voltage gain of the preamplifier is determined by the voltage level at the AGC pin.

ANALOG INPUT (ANA IN)

The ANA IN pin transfers the input signal to the chip for recording. For microphone inputs, the ANA OUT pin should be connected via an external capacitor to the ANA IN pin. This capacitor value, together with the 3 KΩ input impedance at ANA IN, is selected to give additional cutoff at the low-frequency end of the voice passband. If the desired input is derived from a source other than a microphone, the signal can be fed, capacitively coupled, into the ANA IN pin directly.

OPTIONAL EXTERNAL CLOCK (XCLK)

The external clock input for the ISD1100 series devices has an internal pull-down resistor. The ISD1100 series is configured at the factory with an internal sampling clock frequency that guarantees its minimal nominal record/playback time. For instance, an ISD1110 operating within specification will always be observed to have a minimum of 10 seconds of recording time. The sampling frequency is maintained to a total variation of ±2.25 percent over the commercial temperature and operating voltage ranges while still maintaining the minimum duration specified. This will result in some devices having a few percent more than nominal recording time. If greater precision is required, the device can be clocked through the XCLK pin as follows:

Table 2: External Clock Sample Rates

Part Number	Sample Rate	Required Clock
ISD1110	6.4 KHz	819.2 KHz
ISD1112	5.3 KHz	682.7 KHz

These recommended clock rates should not be varied because the antialiasing and smoothing filters are fixed, and aliasing problems can occur if the sample rate differs from the one recommended. The duty cycle on the input clock is not critical, as the clock is immediately divided by two internally. **if the XCLK is not used, this input should be connected to ground.** Please see Application Information for the ISD1100 series for more details on external clocking.

SPEAKER OUTPUTS (SP+, SP–)

The SP+ and SP– pins provide direct drive for loudspeakers with impedances as low as 16 Ω. A single output may be used, but, for direct-drive loudspeakers, the two opposite-polarity outputs provide an improvement in output power of up to four times over a single-ended connection. Furthermore, when SP+ and SP– are used, a speaker-coupling capacitor is not required. A single-ended connection will require an AC-coupling capacitor between the SP pin and the speaker. The speaker outputs are in a high-impedance state during a record cycle, and held at V_{SSA} during power-down.

ADDRESS INPUTS (A0–A7)

The Address Inputs have two functions, depending upon the level of the two Most Significant Bits (MSB) of the address (A6 and A7).

If either of the two MSBs is LOW, the inputs are all interpreted as address bits and are used as the start address for the current record or playback cycle. The address pins are inputs only and do not output internal address information as the operation progresses. Address inputs are latched by the falling edge of $\overline{\text{PLAYE}}$, $\overline{\text{PLAYL}}$ or $\overline{\text{REC}}$. A6 and A7 have internal pull-up devices. A0, A1, A2, A3, A4 and A5 have internal pull-down devices. This allows the signals to be left floating if not used. Each of these internal pull-up or pull-down devices have a value of 50KΩ to 100KΩ.

LOOPING CAPABILITY

The ISD1100 series device has a built-in looping function enabling it to continuously repeat a single message. This is accomplished by taking A3 HIGH to continuously loop from the end of the message to the beginning of the message space. Looping is initiated by a negative transition on $\overline{\text{PLAYE}}$ pin with A7, A6 and A3 held HIGH. Then $\overline{\text{PLAYE}}$ is brought back HIGH. Looping will continue indefinitely with all three control pins ($\overline{\text{PLAYL}}$, $\overline{\text{PLAYE}}$, $\overline{\text{REC}}$) remaining HIGH.

To stop the looping, $\overline{\text{PLAYL}}$ pin is momentarily taken LOW, then back HIGH. As long as A7, A6 and A3 remain HIGH, a new playback loop will begin with the next negative transition on the $\overline{\text{PLAYE}}$ pin.

Another way to control looping is to use $\overline{\text{PLAYL}}$ pin alone. Taking this pin LOW begins the looping and it continues until the pin is taken HIGH again. This is a continuous control rather than the pulsed control of the previous paragraph.

TIMING DIAGRAMS

Figure 2: Record

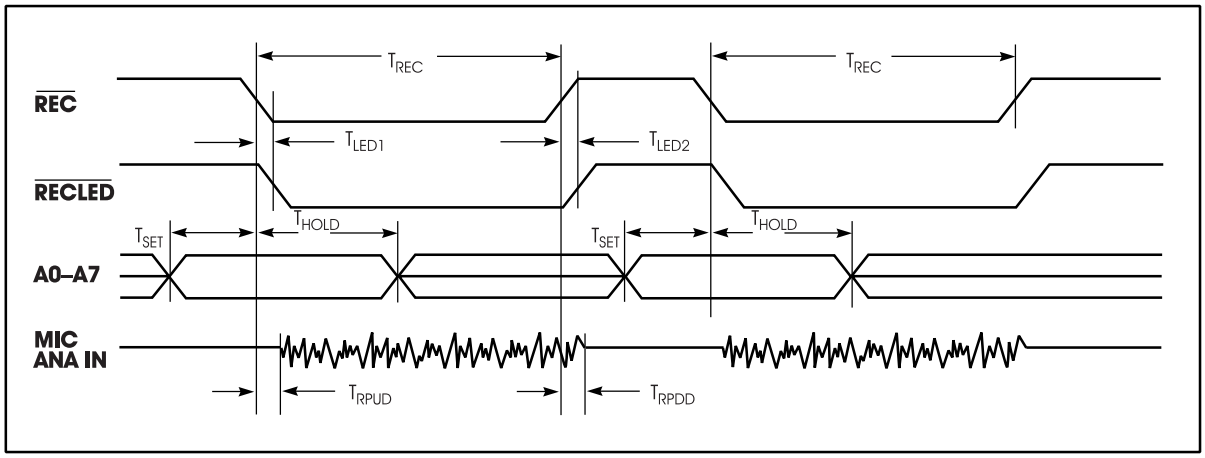
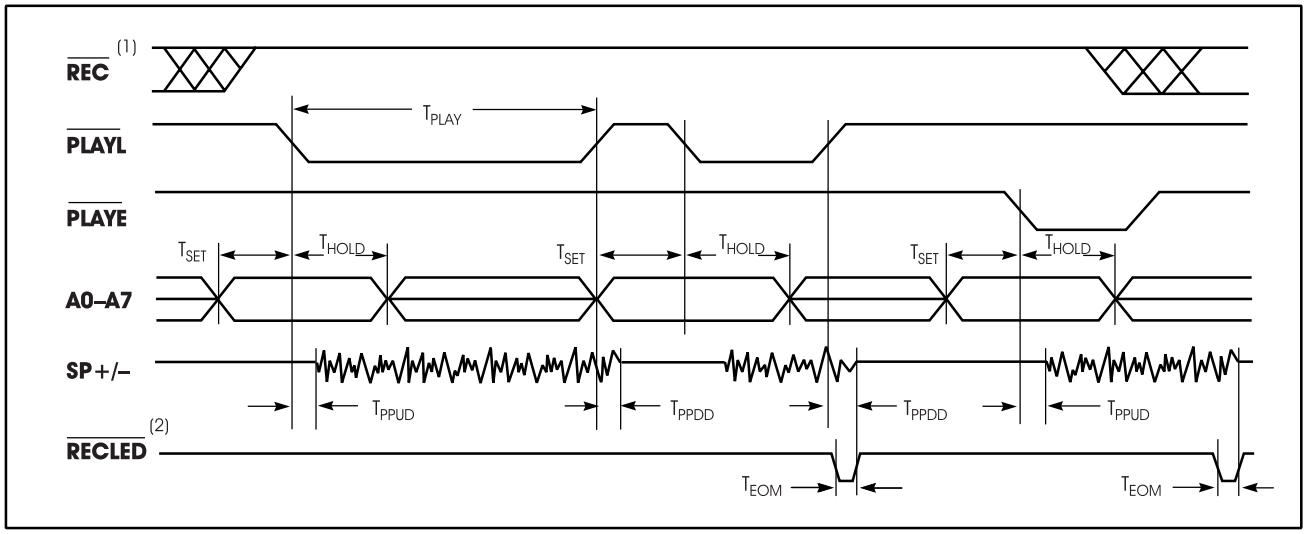


Figure 3: Playback



1. *$\overline{\text{REC}}$ must be HIGH for the entire duration of a playback cycle.*
2. *$\overline{\text{RECLED}}$ functions as an EOM during playback.*

Table 3: Absolute Maximum Ratings (Packaged Parts)[1]

Condition	Value
Junction temperature	150°C
Storage temperature range	–65°C to +150°C
Voltage applied to any pin	(V_{SS} – 0.3 V) to (V_{CC} + 0.3 V)
Voltage applied to any pin (Input current limited to ±20 mA)	(V_{SS} – 1.0 V) to (V_{CC} + 1.0 V)
Lead temperature (soldering – 10 seconds)	300°C
V_{CC} – V_{SS}	–0.3V to +7.0 V

1. *Stresses above those listed may cause permanent damage to the device. Exposure to the absolute maximum ratings may affect device reliability. Functional operation is not implied at these conditions.*

Table 4: Operating Conditions (Packaged Parts)

Condition	Value
Commercial operating temperature range[1]	0°C to +70°C
Supply voltage (V_{CC})[2]	+4.5 V to +5.5 V
Ground voltage (V_{SS})[3]	0 V

1. *Case temperature.*
2. $V_{CC} = V_{CCA} = V_{CCD}$.
3. $V_{SS} = V_{SSA} = V_{SSD}$.

Table 5: DC Parameters (Packaged Parts)

Symbol	Parameters	Min[2]	Typ [1]	Max[2]	Units	Conditions
V_{IL}	Input Low Voltage			0.8	V	
V_{IH}	Input High Voltage	2.4			V	
V_{OL}	Output Low Voltage			0.4	V	I_{OL} = 4.0 mA
V_{OH}	Output High Voltage	2.4			V	I_{OH} = –1.6 mA
I_{CC}	V_{CC} Current (Operating)		15	30	mA	V_{CC} = 5.5 V[3], R_{EXT} = ∞
I_{SB}	V_{CC} Current (Standby)		0.5	2	µA	(3) (4)
I_{IL}	Input Leakage Current			±1	µA	
I_{ILPU}	Input Current LOW w/Pull Up			–130	µA	Force V_{SS} (5)
I_{ILPD}	Input Current HIGH w/Pull Down			130	µA	Force V_{CC} (6)
R_{EXT}	Output Load Impedance	16			Ω	Speaker Load
R_{MIC}	Preamp In Input Resistance		10		KΩ	Pins 17, 18
$R_{ANA\ IN}$	ANA IN Input Resistance		3		KΩ	
A_{PRE1}	Preamp Gain 1		24		dB	AGC = 0.0 V

Table 5: DC Parameters (Packaged Parts)

Symbol	Parameters	Min(2)	Typ (1)	Max(2)	Units	Conditions
A_{PRE2}	Preamp Gain 2		–45	–15	dB	AGC = 2.5 V
A_{ARP}	ANA IN to SP+/- Gain		22		dB	
R_{AGC}	AGC Output Resistance		5		KΩ	
I_{PREH}	Preamp Out Source		–2		mA	@ V_{OUT} = 1.0 V
I_{PREL}	Preamp In Sink		0.5		mA	@ V_{OUT} = 2.0 V

1. *Typical values @ T_A = 25°C and 5.0 V.*
2. *All Min/Max limits are guaranteed by ISD via electrical testing or characterization. Not all specifications are 100 percent tested.*
3. *V_{CCA} and V_{CCD} connected together.*
4. *$\overline{REC}$, $\overline{PLAYL}$, and $\overline{PLAYE}$ must be at V_{CCD}.*
5. *$\overline{REC}$, $\overline{PLAYL}$, and $\overline{PLAYE}$, A6, A7.*
6. *A0–A5, XCLK.*

Table 6: AC Parameters (Packaged Parts)

Symbol	Characteristic		Min(2)	Typ (1)	Max(2)	Units	Conditions
F_S	Sampling Frequency	ISD1110 ISD1112			6.4 5.3	KHz KHz	(5) (5)
F_{CF}	Filter Pass Band	ISD1110 ISD1112		2.6 2.2		KHz KHz	3 dB Roll-Off Point(3)(6) 3 dB Roll-Off Point(3)(6)
T_{REC}	Record Duration	ISD1110 ISD1112	10 12			sec sec	
T_{PLAY}	Playback Duration	ISD1110 ISD1112	10 12			sec sec	(5) (5)
T_{LED1}	$\overline{RECLED}$ ON Delay			5		µsec	
T_{LED2}	$\overline{RECLED}$ OFF Delay	ISD1110 ISD1112	40 50	48.5 58.3	100 105	msec msec	
T_{SET}	A0–A7 Setup Time		300			nsec	
T_{HOLD}	A0–A7 Hold Time		0			nsec	
T_{RPUD}	Record Power-Up Delay	ISD1110 ISD1112		32 39		msec msec	
T_{RPDD}	Record Power-Down Delay	ISD1110 ISD1112		32 39		msec msec	
T_{PPUD}	Play Power-Up Delay	ISD1110 ISD1112		32 39		msec msec	
T_{PPDD}	Play Power-Down Delay	ISD1110 ISD1112		8.1 9.7		msec msec	

Table 6: AC Parameters (Packaged Parts)

Symbol	Characteristic	Min(2)	Typ (1)	Max(2)	Units	Conditions
T_{EOM}	EOM Pulse Width ISD1110 ISD1112		15.62 5 18.75		msec msec	
THD	Total Harmonic Distortion		1		%	@ 1 KHz
P_{OUT}	Speaker Output Power		12.2		mW	R_{EXT} = 16 Ω
V_{OUT}	Voltage Across Speaker Pins		1.25	2.5	MVp–p	R_{EXT} = 600 Ω
V_{IN1}	MIC Input Voltage			20	mV	Peak-to-Peak(4)
V_{IN2}	ANA IN Input Voltage			50	mV	Peak-to-Peak

1. *Typical values @ T_A = 25°C and 5.0 V.*
2. *All Min/Max limits are guaranteed by ISD via electrical testing or characterization. Not all specifications are 100 percent tested.*
3. *Low-frequency cutoff depends upon value of external capacitors (see Pin Descriptions).*
4. *With 5.1 KΩ series resistor at ANA IN.*
5. *Sampling frequency and playback duration will vary as much as ±2.25 percent over the commercial temperature and voltage ranges. All devices will meet the maximum sampling frequency and minimum playback duration parameters. For greater stability, an external clock can be utilized (see Pin Descriptions).*
6. *Filter specification applies to the antialiasing filter and the smoothing filter.*

TYPICAL PARAMETER VARIATION WITH VOLTAGE AND TEMPERATURE (PACKAGED PARTS)

Chart 1: Record Mode Operating Current (I_{CC})

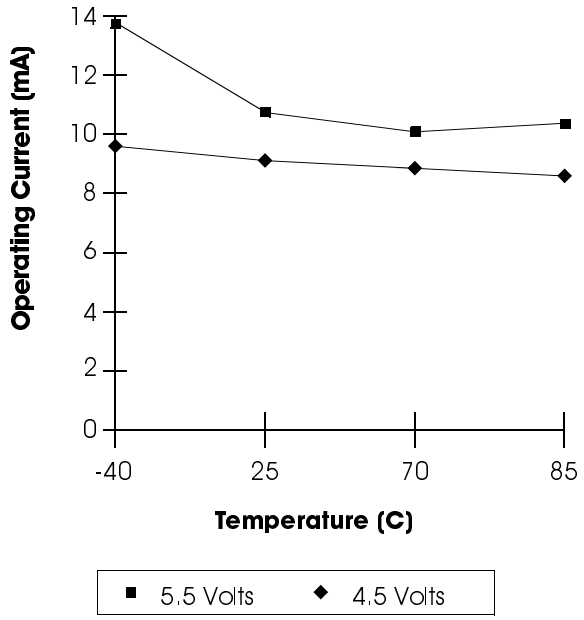


Chart 2: Total Harmonic Distortion

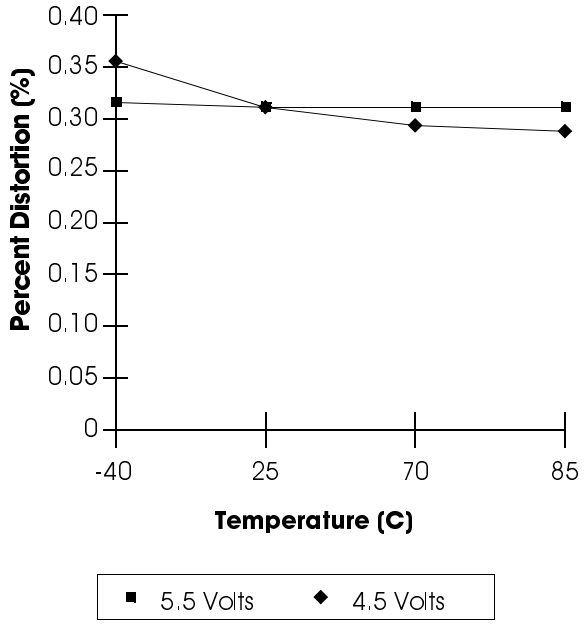


Chart 3: Standby Current (I_{SB})

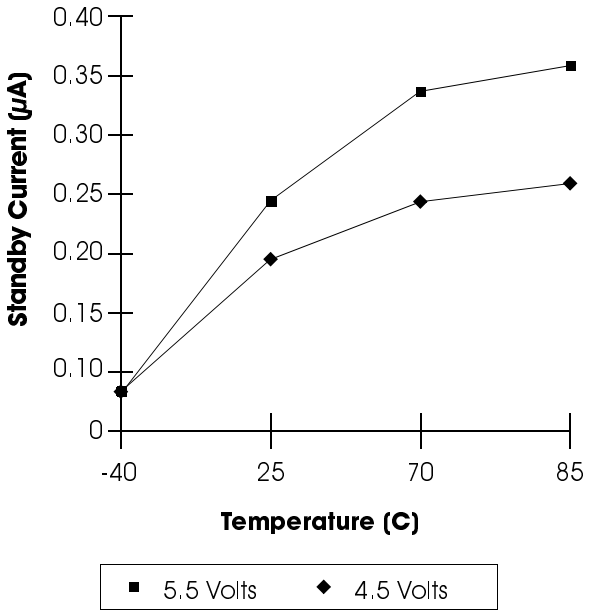


Chart 4: Oscillator Stability

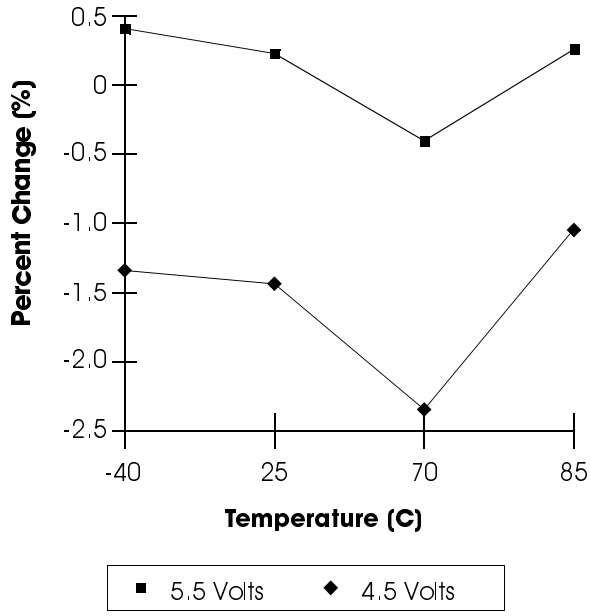


Table 7: Absolute Maximum Ratings (Die)[1]

Condition	Value
Junction temperature	150°C
Storage temperature range	–65°C to +150°C
Voltage applied to any pad	(V_{SS} – 0.3 V) to (V_{CC} + 0.3 V)
Voltage applied to any pad (Input current limited to ±20 mA)	(V_{SS} – 1.0 V) to (V_{CC} + 1.0 V)
V_{CC} – V_{SS}	–0.3 V to +7.0 V

1. *Stresses above those listed may cause permanent damage to the device. Exposure to the absolute maximum ratings may affect device reliability. Functional operation is not implied at these conditions.*

Table 8: Operating Conditions (Die)

Condition	Value
Operating temperature range	0°C to +50°C
Supply voltage (V_{CC})[1]	+4.5 V to +6.5 V
Ground voltage (V_{SS})[2]	0 V

1. $V_{CC} = V_{CCA} = V_{CCD}$.
2. $V_{SS} = V_{SSA} = V_{SSD}$.

Table 9: DC Parameters (Die)

Symbol	Parameters	Min[2]	Typ[1]	Max[2]	Units	Conditions
V_{IL}	Input Low Voltage			0.8	V	
V_{IH}	Input High Voltage	2.4			V	
V_{OL}	Output Low Voltage			0.4	V	I_{OL} = 4.0 mA
V_{OH}	Output High Voltage	2.4			V	I_{OH} = –1.6 mA
I_{CC}	V_{CC} Current (Operating)		15	30	mA	V_{CC} = 5.5 V[3], R_{EXT} = ∞
I_{SB}	V_{CC} Current (Standby)		0.5	2	µA	[3] [4]
I_{IL}	Input Leakage Current			±1	µA	
I_{ILPU}	Input Current LOW w/Pull Up			–130	µA	Force V_{SS} [5]
I_{ILPD}	Input Current HIGH w/Pull Down			130	µA	Force V_{CC} [6]
R_{EXT}	Output Load Impedance	16			Ω	Speaker Load
R_{MIC}	Preamp In Input Resistance		10		KΩ	Pins 17, 18
$R_{ANA\ IN}$	ANA IN Input Resistance		3		KΩ	
A_{PRE1}	Preamp Gain 1		24		dB	AGC = 0.0 V
A_{PRE2}	Preamp Gain 2		–45	–15	dB	AGC = 2.5 V

Table 9: DC Parameters (Die)

Symbol	Parameters	Min(2)	Typ(1)	Max(2)	Units	Conditions
A_{ARP}	ANA IN to SP+/- Gain		22		dB	
R_{AGC}	AGC Output Resistance		5		KΩ	
I_{PREH}	Preamp Out Source		–2		mA	@ V_{OUT} = 1.0 V
I_{PREL}	Preamp In Sink		0.5		mA	@ V_{OUT} = 2.0 V

1. *Typical values @ T_A = 25°C and 5.0 V.*
2. *All Min/Max limits are guaranteed by ISD via electrical testing or characterization. Not all specifications are 100 percent tested.*
3. *V_{CCA} and V_{CCD} connected together.*
4. *$\overline{REC}$, $\overline{PLAYL}$, and $\overline{PLAYE}$ must be at V_{CCD}.*
5. *$\overline{REC}$, $\overline{PLAYL}$, and $\overline{PLAYE}$, A6, A7.*
6. *A0–A5, XCLK.*

Table 10: AC Parameters (Die)

Symbol	Characteristic		Min(2)	Typ(1)	Max(2)	Units	Conditions
F_S	Sampling Frequency	ISD1110 ISD1112			6.4 5.3	KHz KHz	(5) (5)
F_{CF}	Filter Pass Band	ISD1110 ISD1112		2.6 2.2		KHz KHz	3 dB Roll-Off Point(3)(6) 3 dB Roll-Off Point(3)(6)
T_{REC}	Record Duration	ISD1110 ISD1112	10 12			sec sec	
T_{PLAY}	Playback Duration	ISD1110 ISD1112	10 12			sec sec	(5) (5)
T_{LED1}	$\overline{RECLED}$ ON Delay			5		µsec	
T_{LED2}	$\overline{RECLED}$ OFF Delay	ISD1110 ISD1112	40 50	48.5 58.3	100 105	msec msec	
T_{SET}	A0–A7 Setup Time		300			nsec	
T_{HOLD}	A0–A7 Hold Time		0			nsec	
T_{RPUD}	Record Power-Up Delay	ISD1110 ISD1112		32 39		msec msec	
T_{RPDD}	Record Power-Down Delay	ISD1110 ISD1112		32 39		msec msec	
T_{PPUD}	Play Power-Up Delay	ISD1110 ISD1112		32 39		msec msec	
T_{PPDD}	Play Power-Down Delay	ISD1110 ISD1112		8.1 9.7		msec msec	

Table 10: AC Parameters (Die)

Symbol	Characteristic		Min(2)	Typ(1)	Max(2)	Units	Conditions
T_{EOM}	EOM Pulse Width	ISD1110 ISD1112		15.625 18.75		msec msec	
THD	Total Harmonic Distortion			1		%	@ 1 KHz
P_{OUT}	Speaker Output Power			12.2		mW	R_{EXT} = 16 Ω
V_{OUT}	Voltage Across Speaker Pins			1.25	2.5	mVp-p	R_{EXT} = 600 Ω
V_{IN1}	MIC Input Voltage				20	mV	Peak-to-Peak(4)
V_{IN2}	ANA IN Input Voltage				50	mV	Peak-to-Peak

1. *Typical values @ T_A = 25°C and 5.0 V.*
2. *All Min/Max limits are guaranteed by ISD via electrical testing or characterization. Not all specifications are 100 percent tested.*
3. *Low-frequency cutoff depends upon value of external capacitors (see Pin Descriptions).*
4. *With 5.1 KΩ series resistor at ANA IN.*
5. *Sampling frequency and playback duration will vary as much as ±2.25 percent over the commercial temperature and voltage ranges. All devices will meet the maximum sampling frequency and minimum playback duration parameters. For greater stability, an external clock can be utilized (see Pin Descriptions).*
6. *Filter specification applies to the antialiasing filter and to the smoothing filter.*

TYPICAL PARAMETER VARIATION WITH VOLTAGE AND TEMPERATURE (DIE)

Chart 5: Record Mode Operating Current (I_{CC})

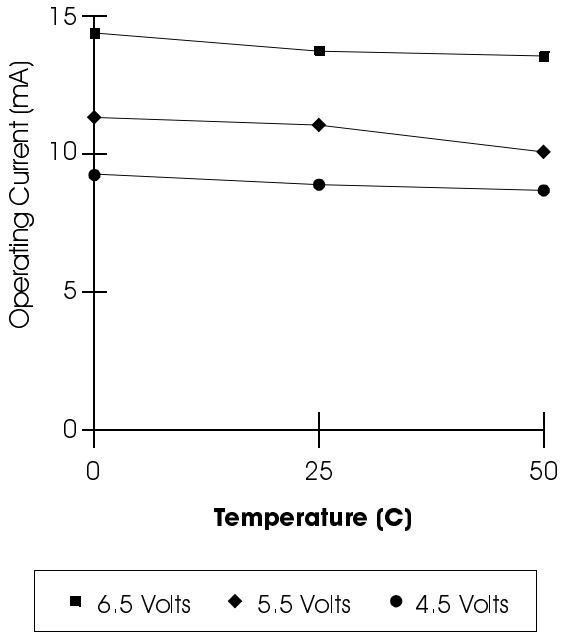


Chart 6: Total Harmonic Distortion

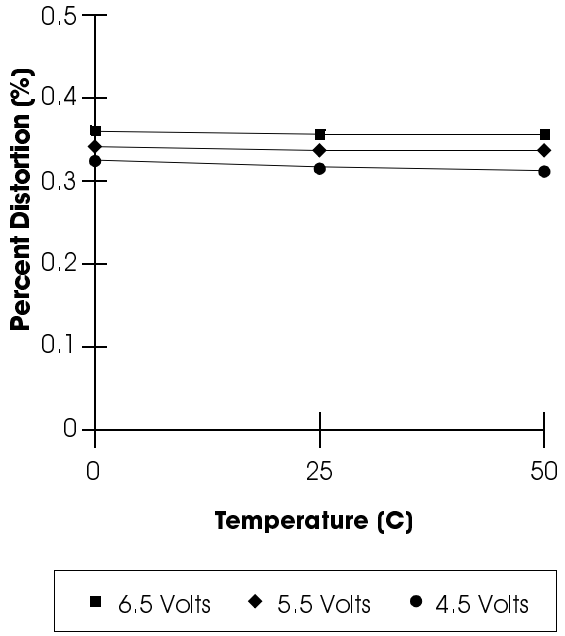


Chart 7: Standby Current (I_{SB})

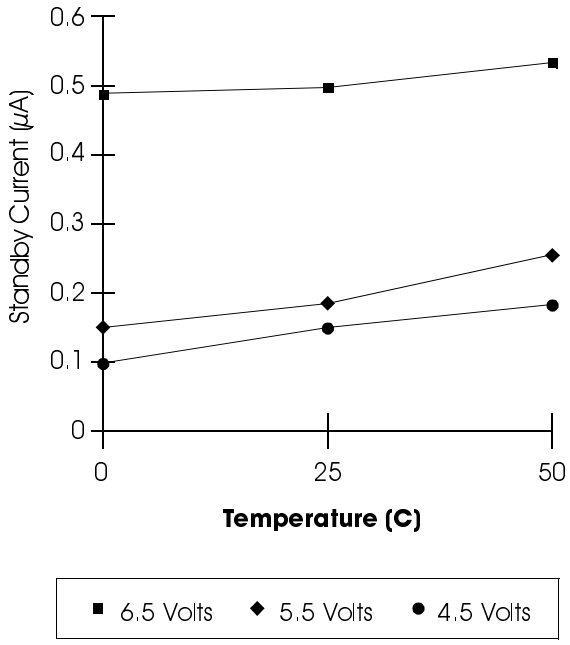


Chart 8: Oscillator Stability

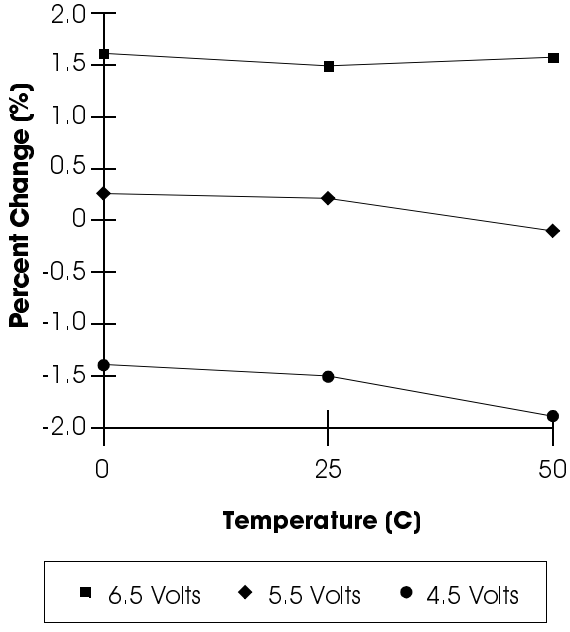
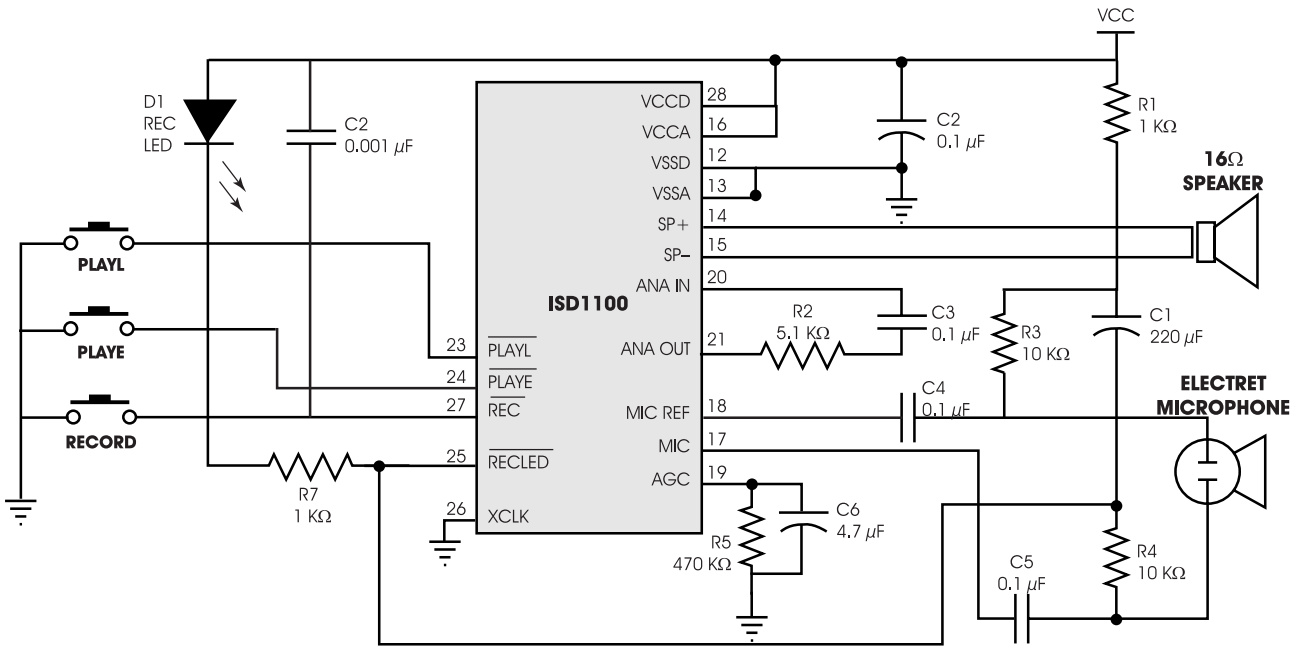


Figure 4: Application Example



FUNCTIONAL DESCRIPTION EXAMPLE

The following example operating sequence demonstrates the functionality of the ISD1100 series devices.

1. Record a message filling the memory.

   Pulling the $\overline{\text{REC}}$ signal LOW initiates a record cycle from the beginning of the message space. If $\overline{\text{REC}}$ is held LOW, the recording continues until the message space has been filled. Once the message space is filled, recording ceases. The device will automatically power down after $\overline{\text{REC}}$ is released HIGH. An EOM marker is written at the end of memory.

2. Edge-activated playback.

   Pulling the $\overline{\text{PLAYE}}$ signal LOW initiates a playback cycle from the beginning of the message space. The rising edge of $\overline{\text{PLAYE}}$ has no effect on operation. If a recording has filled the message space, the entire message is played. When the device reaches the EOM marker, it automatically powers down. A subsequent falling edge on $\overline{\text{PLAYE}}$ initiates a new play cycle from the beginning of the memory.

3. Level-activated playback.

   Pulling the $\overline{\text{PLAYL}}$ signal LOW initiates a playback cycle from the beginning of the message space. If recording has filled the message space, the entire message is played. When the device reaches the EOM marker, it automatically powers down. A subsequent falling edge on $\overline{\text{PLAYL}}$ initiates a new play cycle from the starting address.

4. Level-activated playback (truncated).

   If $\overline{\text{PLAYL}}$ is pulled HIGH any time during the playback cycle, the device stops playing and enters the power-down mode. A subsequent falling edge on $\overline{\text{PLAYL}}$ initiates a new play cycle from the beginning of memory.

5. Record (interrupting playback).

   The $\overline{REC}$ signal takes precedence over other operations. Any LOW-going transition on $\overline{REC}$ initiates a new record operation from the beginning of the memory, regardless of any current operation in progress.

6. Record a message, partially filling the memory.

   A record operation need not fill the entire memory. Releasing the $\overline{REC}$ signal HIGH before filling the message space causes the recording to stop and an EOM marker to be placed. The device powers down automatically.

7. Play back a message that partially fills the memory.

   Pulling the $\overline{PLAYE}$ or $\overline{PLAYL}$ signal LOW initiates a playback cycle which is then completed when the EOM marker is encountered. Playback ceases and the device powers down.

8. $\overline{RECLED}$ operation.

   The $\overline{RECLED}$ output pin provides an active-LOW signal which can be used to drive an LED as a "record-in- progress" indicator. It returns to a HIGH state when the $\overline{REC}$ pin is released HIGH or when the recording is completed due to the memory being filled. This pin also pulses LOW to indicate an EOM at the end of a message being played.

APPLICATIONS NOTE

Some users may experience an unexpected recording taking place when their circuit is powered up, or the batteries are changed, and V_{CC} rises faster than $\overline{REC}$. This undesired recording prevents playback of the previously recorded message. A spurious EOM marker may appear at the very beginning of the memory, preventing access to the original message, and nothing is played.

To prevent this occurrence, place a capacitor (approximately. 0.001 μF) between the control pin, $\overline{REC}$, and V_{CC}. This pulls the control pin voltage up with V_{CC} as it rises. Once the voltage is HIGH, the pull-up device will keep the pin HIGH until intentionally pulled LOW, preventing the false EOM marker.

Since this condition is dependent upon factors such as the capacitance of the user's printed circuit board, not all circuit designs will exhibit the spurious marker. It is recommended, however, that the capacitor is included for design reliability. A more detailed explanation and resolution of this occurrence is described in Application Information.

ISD1100 SERIES PHYSICAL DIMENSIONS

Figure 5: 28-Lead 0.600-Inch Plastic Dual Inline Package (PDIP) (P)

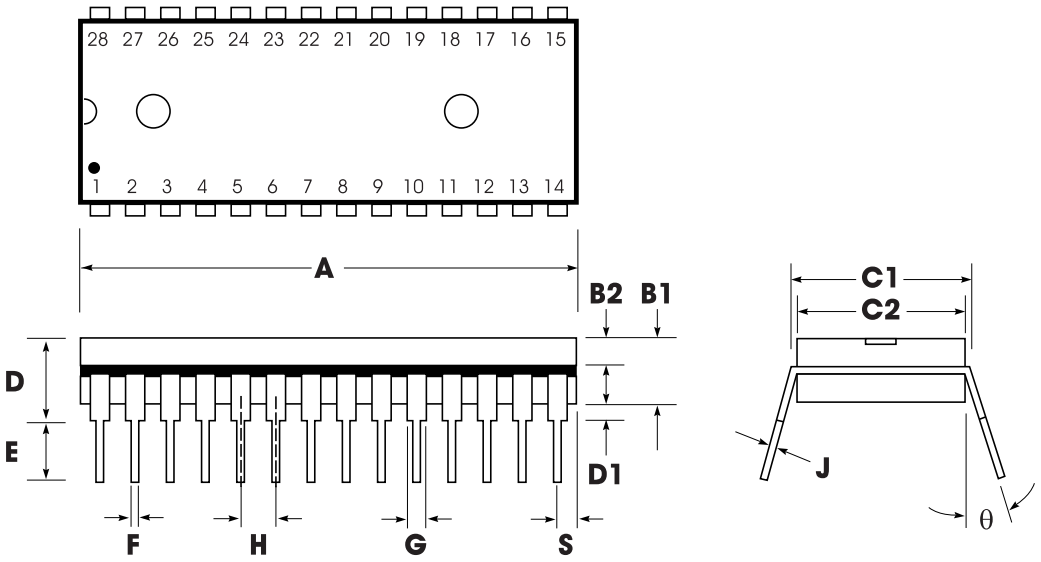


Table 11: Plastic Dual Inline Package (PDIP) (P) Dimensions

	INCHES			MILLIMETERS		
	Min	Nom	Max	Min	Nom	Max
A	1.445	1.450	1.455	36.70	36.83	36.96
B1		0.150			3.81	
B2	0.065	0.070	0.075	1.65	1.78	1.91
C1	0.600		0.625	15.24		15.88
C2	0.530	0.540	0.550	13.46	13.72	13.97
D			0.19			4.83
D1	0.015			0.38		
E	0.125		0.135	3.18		3.43
F	0.015	0.018	0.022	0.38	0.46	0.56
G	0.055	0.060	0.065	1.40	1.52	1.65
H		0.100			2.54	
J	0.008	0.010	0.012	0.20	0.25	0.30
S	0.070	0.075	0.080	1.78	1.91	2.03
q	0°		15°	0°		15°

NOTE: *Lead coplanarity to be within 0.005 inches.*

Figure 6: 28-Lead 0.300-Inch Plastic Small OutLine Integrated Circuit (SOIC) (S)

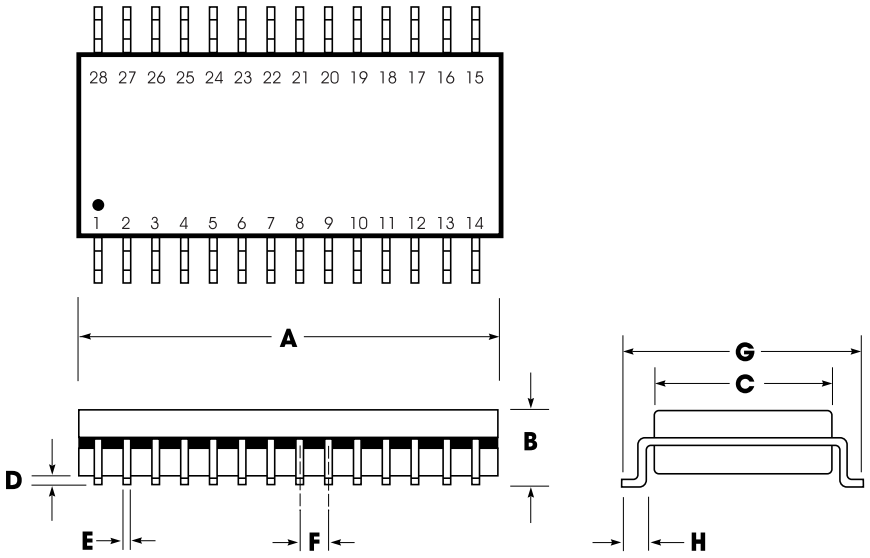


Table 12: Plastic Small OutLine Integrated Circuit (SOIC) (S) Dimensions

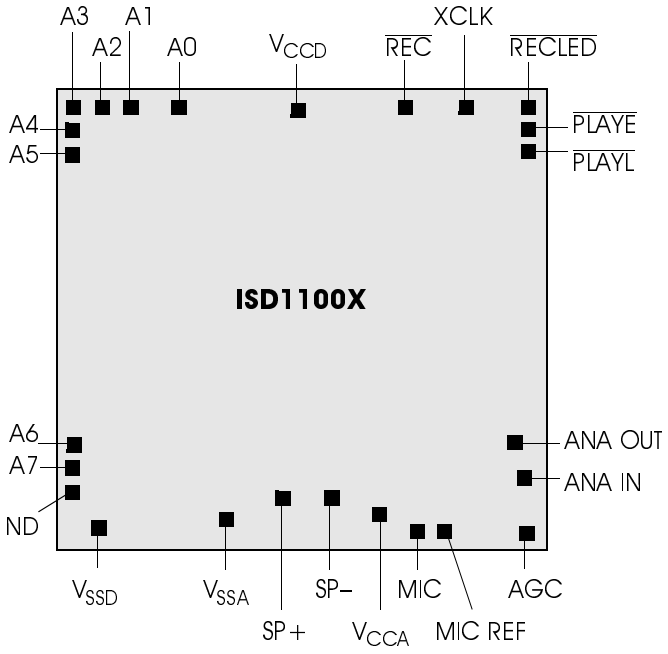
	INCHES			MILLIMETERSþ		
	Min	Nom	Max	Min	Nom	Max
A	0.701	0.706	0.711	17.81	17.93	18.06
B	0.097	0.101	0.104	2.46	2.56	2.64
C	0.292	0.296	0.299	7.42	7.52	7.59
D	0.005	0.009	0.0115	0.127	0.22	0.29
E	0.014	0.016	0.019	0.35	0.41	0.48
F		0.050			1.27	
G	0.400	0.406	0.410	10.16	10.31	10.41
H	0.024	0.032	0.040	0.61	0.81	1.02

NOTE: *Lead coplanarity to be within 0.004 inches.*

Figure 7: ISD1100 Series Bonding Physical Layout[1]

ISD1100X

- **I.** Die Dimensions
  X: 172.2 ±1 mils
  Y: 138.2 ±1 mils
- **I.** Die Thickness[(2)]
  17.5 ±1 mils
- **I.** Pad Opening
  88 x 112 microns
  3.46 x 4.41 mils



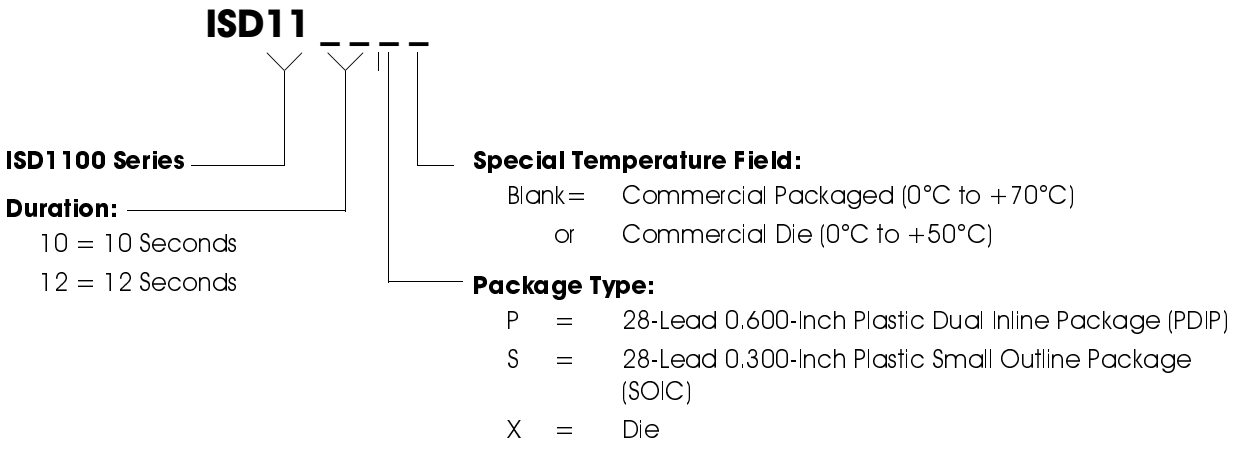
1. *The backside of die is internally connected to V_{SS}. It **MUST NOT** be connected to any other potential or damage may occur.*
2. *Die thickness is subject to change, please contact ISD factory for status.*

Table 13: ISD1100 Series PIN/PAD Designations, with Respect to Die Center (µm)

Pin	Pin Name	X Axis	Y Axis
A0	Address 0	–1364.0	1589.6
A1	Address 1	–1648.4	1589.6
A2	Address 2	–1816.4	1589.6
A3	Address 3	–2013.6	1515.6
A4	Address 4	–2013.6	1337.6
A5	Address 5	–2013.6	1129.6
A6	Address 6	–2013.6	–831.2
A7	Address 7	–2013.6	–1022.0
NC	No Connect	–2013.6	–1361.6
V_{SSD}	V_{SS} Digital Power Supply	–1893.6	–1588.0
V_{SSA}	V_{SS} Analog Power Supply	–357.6	–1588.0
SP+	Speaker Output +	–17.2	–1512.8
SP–	Speaker Output –	412.4	–1512.8
V_{CCA}	V_{CC} Analog Power Supply	780.0	–1552.4
MIC	Microphone Input	992.0	–1590.0
MIC REF	Microphone Reference	1169.2	–1590.0
AGC	Automatic Gain Control	1978.4	–1590.0
ANA IN	Analog Input	2005.6	–1196.4
ANA OUT	Analog Output	1991.2	–995.2
$\overline{\text{PLAYL}}$	Level-Activated Playback	2014.4	1224.4
$\overline{\text{PLAYE}}$	Edge-Activated Playback	2014.4	1392.8
$\overline{\text{RECLED}}$	Record LED Output	2012.4	1587.6
XCLK	No Connect (optional)	1581.2	1589.6
$\overline{\text{REC}}$	Record	752.8	1589.6
V_{CCD}	V_{CC} Digital Power Supply	–48.0	1545.2

ORDERING INFORMATION

Product Number Descriptor Key



When ordering ISD1100 series devices, please refer to the following valid part numbers.

Part Number	Part Number
ISD1110P	ISD1112P
ISD1110X	ISD1112X
ISD1110S	ISD1112S

For the latest product information, access ISD's worldwide website at http://www.isd.com.